

## CLAIMS

1. A device for detecting a target substance  
in a fluid, comprising  
5 a periodic structure having a vacant portion for  
passing a fluid containing the target substance and a  
solid portion capable of transmitting an  
electromagnetic wave arranged regularly to form a  
periodic distribution of a refractive index for the  
10 electromagnetic wave,  
an electromagnetic wave-projecting means for  
projecting the electromagnetic wave to the periodic  
structure, and  
a detecting means for measuring the magnetic wave  
15 emitted from the periodic structure to detect a  
change in the periodic distribution of the refractive  
index.

2. The device according claim 1, wherein a  
trapping substance capable of bonding selectively to  
20 the target substance is disposed on the surface of  
the solid portion, and a change in the periodic  
distribution of the refractive index caused by  
bonding the target substance to the trapping  
substance is detected.

25 3. The device according to claim 1, wherein  
the periodic structure forbids transmission of the  
electromagnetic wave in a specific wavelength band

depending on the periodic distribution of the refractive index.

4. The device according to claim 3, wherein the electromagnetic wave-projecting means for  
5 projecting the electromagnetic wave projects an electromagnetic wave with a wavelength near an edge of the wavelength band and the detecting means measures the intensity of emitted electromagnetic wave.

10 5. The device according to claim 3, wherein the periodic structure has a defect in the regular arrangement of the vacant portion and the solid portion to provide an electromagnetic wave-transmissive wavelength range in the wavelength band  
15 where the electromagnetic wave propagation is forbidden, the electromagnetic wave-projecting means projects the electromagnetic wave in the electromagnetic wave-transmissive wavelength range to the periodic structure, and the detecting means  
20 measures the electromagnetic wave of the electromagnetic wave-transmissive wavelength range emitted from the periodic structure.

6. The device according to claim 1, wherein the device has additionally a temperature-controlling  
25 means for controlling the temperature of the periodic structure.

7. The device according to claim 1, wherein

the device has additionally a polarization-controlling means for controlling polarization of the electromagnetic wave.

8. The device according to claim 1, wherein  
5 the electromagnetic wave projected to the periodic structure has a continuous wavelength component, and the detecting means measures the spectrum of the electromagnetic wave emitted from the periodic structure.

10 9. The device according to claim 1, wherein the electromagnetic wave is projected through a collimating means onto the periodic structure, and the detecting means measures the direction of transmission of the electromagnetic wave.

15 10. The device according to claim 1, wherein the device has additionally a first aligning means for aligning the electromagnetic wave emitted from the electromagnetic wave-projecting means to enter the periodic structure at a prescribed position at a  
20 prescribed angle, and a second aligning means for aligning the electromagnetic wave to reach the detecting means.

11. The device according to claim 1, wherein the solid portions of the structure are columnar, and  
25 the vacant portion is an interstice among the structure.

12. The device according to claim 1, wherein

the solid portion is a continuous body and the vacant portion is constituted of holes penetrating the continuous body.

13. A device for detecting a target substance  
5 in a fluid, comprising  
a flow path for passing a fluid containing the target substance,  
a periodic structure placed at least a portion of the flow path and having a vacant portion for passing the  
10 fluid containing the target substance and a solid portion capable of transmitting an electromagnetic wave arranged regularly to form a periodic distribution of a refractive index for the electromagnetic wave,  
15 an electromagnetic wave-projecting means for projecting the electromagnetic wave to the periodic structure, and  
a detecting means for measuring the magnetic wave emitted from the periodic structure to detect a  
20 change in the periodic distribution of a refractive index.

14. The device according to claim 13, wherein the periodic structure has periodic distribution of the refractive index in a direction perpendicular to  
25 the flow path, and the electromagnetic wave is projected in the direction.

15. The device according to claim 13, wherein

the periodic structure has periodic distribution of the refractive index in a direction parallel to the flow path, and the electromagnetic wave is projected in the direction.

5           16. The device according to claim 13, wherein the periodic structure has columnar solid portions regularly placed two-dimensionally with an interspace, and the plane of the periodic structure is parallel to the flow path.

10           17. The device according to claim 13, wherein the periodic structure is a two-dimensional periodic structure which has a continuous solid body and holes regularly placed and penetrating the continuous body, and the holes are parallel to the flow path.

15           18. A device for detecting plural target substances in a fluid, comprising  
a flow path for passing a fluid containing the target substances;  
plural periodic structures each of which is placed at  
20 least a portion of the flow path and has a vacant portion for passing the fluid containing the target substances and a solid portion capable of  
transmitting an electromagnetic wave arranged  
regularly to form a periodic distribution of a  
25 refractive index for the electromagnetic wave,  
an electromagnetic wave-projecting means for  
projecting the electromagnetic wave to the periodic

structures, and  
a detecting means for measuring the magnetic wave  
emitted from the periodic structures to detect a  
change in the periodic distribution of the refractive  
5 index.

19. The device according to claim 18, wherein  
the periodic structure forbids transmission of a  
specific wavelength band of the electromagnetic wave  
defined by the periodic distribution of the  
10 refractive index.

20. The device according to claim 18, wherein  
the periodic structures have respectively a different  
trapping substance distributed on the surface of the  
solid portion and capable of bonding to one of the  
15 target substances; and the detecting means detects  
the respective changes in the periodic distribution  
of the refractive indexes caused by the target  
substance and the trapping substance.

21. The device according to claim 19, wherein  
20 the plural periodic structures are placed in series  
along the flow path, and plural electromagnetic wave-  
projecting means for projecting the electromagnetic  
wave in the direction perpendicular to the flow path  
to the respective periodic structure, and plural  
25 detecting parts for detecting the magnetic waves  
emitted from the periodic structures are provided.

22. The device according to claim 21, wherein

the periodic structures have the same construction in the same dimension, and the electromagnetic wave-projecting means project respectively an electromagnetic wave of the wavelength near the band edge of the wavelength band while the trapping substances capable of bonding to target substances are distributed on the surface of the solid portion.

23. The device according to claim 22, wherein the periodic structures have respectively a nearly the same band edge wavelength of the wavelength band in a state that the trapping substances capable of bonding to target substances are distributed on the surface of the solid portion, and the electromagnetic wave-projecting means project respectively an electromagnetic wave of the band edge wavelength.

24. The device according to claim 18, wherein the electromagnetic waves projected to the periodic structures are generated from one and the same electromagnetic wave source, and the produced electromagnetic wave is split and projected to the periodic structures.

25. The device according to claim 19, wherein the plural periodic structures are placed in series along the flow path, and plural electromagnetic wave-projecting means for projecting the electromagnetic wave in the direction parallel to the flow path to the respective periodic structure, and plural

detecting parts for detecting the magnetic waves emitted from the periodic structures are provided.

26. The device according to claim 25, wherein the periodic structures have the wavelengths not  
5 overlapping with each other, and the projected electromagnetic wave is emitted from a wavelength-variable electromagnetic wave source including the band edge wavelengths of the wavelength bands.

27. The device according to claim 19, wherein  
10 the plural periodic structures are placed in parallel in the flow path, and an electromagnetic wave-projecting means for projecting the electromagnetic wave in the parallel placement to the respective periodic structures, and a detecting unit for  
15 detecting the magnetic wave transmitted and emitted from the periodic structures are provided.

28. The device according to claim 27, wherein the periodic structures have the wavelengths not overlapping with each other, and the projected  
20 electromagnetic wave is emitted from a wavelength-variable electromagnetic wave source including the band edge wavelengths of the wavelength bands.

29. A device for detecting a target substance in a fluid, comprising  
25 an optical fiber having plural holes for passing the fluid containing the target substance and a solid portion capable of transmitting an electromagnetic

wave to form a refractive index distribution in the  
radius direction,  
an electromagnetic wave-introducing means for  
introducing the electromagnetic wave to the optical  
5 fiber, and  
a detecting means for measuring the magnetic wave  
emitted from the optical fiber in the radius  
direction to detect a change in a refractive index.

30. The device according to claim 29, wherein  
10 the optical fiber is a photonic crystal fiber having  
plural holes arranged regularly and having periodic  
structure of the refractive index in the fiber radius  
direction.

31. The device according to claim 30, wherein  
15 the trapping substance for bonding selectively to the  
target substance is disposed on the surface of the  
holes.